Equilibrium Price Dynamics in Perishable Goods Markets: The Case of Secondary Markets for Major League Baseball Tickets

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Introduction

- aim: describe equilibrium pricing patterns and test theories of equilibrium pricing behavior in perishable goods markets
- event tickets are *perishable goods* with *fixed date consumption*
  - worthless once the game is played
  - cannot be consumed before the game is played
examples: McAfee and te Velde (2006), Gallego and van Ryzin (1994)

basic theoretical structure:

- seller starts with a given inventory and continuously varies price (no commitment)
- consumers arrive randomly, purchase at once or exit
- demand parameters constant over time
- market ends (inventory perishes) on a fixed date

optimal price depends on probability that a current sale prevents a future one because of a stock-out

- lower inventory $\rightarrow$ higher prices
- less time remaining $\rightarrow$ lower prices, as future selling opportunities disappear

a “robust prediction” (McAfee and te Velde) is that expected prices should fall over time
little empirical work testing these models
when declining price prediction has been tested (e.g., airlines by McAfee and te Velde), it has been rejected. Why?

- consumer demand changes over time
- commitment

secondary event ticket markets have several nice features:

- sellers are small and fairly anonymous, so commitment incentives should be small
- most sellers offering one unit (e.g., a pair of tix), so declining price prediction emerges unambiguously
What the Paper Does

1 shows, using data from two large markets, that list and transaction prices decline by significant amounts (20-50%) as the game approaches.

2 describes three theories for why prices decline:
   - RM explanation
   - residual demand becomes more elastic over time
   - seller learning (e.g., Lazear (1986))

3 rejects 3 using reduced-form evidence; shows 1 preferred to 2 by estimating models of the seller’s price-setting problem.

4 show most observed early purchasing rationalized by plausible ‘return to market’/search costs & risk-neutrality given product differentiation and uncertainties about availability of particular types of ticket.
(Descriptive) Evidence of Price Declines

- estimating equation:
  \[
  \text{Price or Log(Price)} = DTG\beta^{DTG} + X^{LIST}\beta^{LIST} \\
  + X^{SLR}\beta^{SLR} + X^{FORM}\beta^{FORM} + FEs + \epsilon
  \]

- measure of price:
  - buyer, seller
  - transaction, list
  - log, levels or relative to face value

- definition of fixed effects, important to control for quality:
  - game-section “Seattle Mariners at New York Yankees on May 6, Loge Box 512” and include row controls; or,
  - game-section-row; or,
  - ticket/seller-game-section
Price Declines in Stubhub List Prices and EBay Transaction Prices

Listed Fixed Prices on Stubhub
Game-Section-Row Fixed Effects
N=3,361,062

Transaction Prices on EBay
Game-Section-Row Fixed Effects
N=300,379
Listed Auction Start Prices on EBay
Game-Section Fixed Effects
N=450,425

Listed Fixed Prices on EBay
Game-Section Fixed Effects
N=390,834
EBay List Fixed Price and Auction Start Prices

Listed Fixed Prices on EBay
Ticket (Game-Section-Row-Seller) Fixed Effects

Listed Auction Start Prices on EBay
Ticket (Game-Section-Row-Seller) Fixed Effects

Days to Go Until Game

% Increase in Price Above Level 0-2 Days Prior to
Game For Auction Start Prices

% Increase in Price Above Level 0-2 Days Prior to
Game For Fixed Prices
Theoretical Explanations for Why Sellers Cut Prices
Explanations 1 and 2: Declining Opportunity Costs and Changing Elasticities

- fixed price listing, two periods, sets price $p_t$, gets $v$ if unsold after $t = 2$

$$\max_{p_1, p_2} p_1 Q_1(p_1) + p_2 Q_2(p_2)(1 - Q_1(p_1)) + v(1 - Q_2(p_2))(1 - Q_1(p_1))$$

FOCs: $Q_1(p_1^*) + \frac{\partial Q_1(p_1^*)}{\partial p_1} [p_1^* - (p_2^* Q_2(p_2^*) + (1 - Q_2(p_2^*))v)] = 0$

$$Q_2(p_2^*) + \frac{\partial Q_2(p_2^*)}{\partial p_2} [p_2^* - v] = 0$$

- opportunity cost of selling is $v$ in period 2,
  $p_2^* Q_2(p_2^*) + (1 - Q_2(p_2^*))v$ in period 1
- if $Q_1(p_1) \equiv Q_2(p_2)$, $p_1^* > p_2^*$
- explanation 1: prices fall because of declining opportunity costs
- explanation 2: prices fall because of changing demand elasticities
Structural Analysis of Price Setting
Testing the Changing Demand & Declining Opportunity Cost Explanations: Example
Fixed Price Listings

whenever a seller lists a ticket he is solving

$$\max_{p_{st}} p_{st} Q_{st}(p_{st}) + o_{st}(1 - Q_{st}(p_{st}))$$

where $Q_{st}$ is the probability of sale and $o_{st}$ is the opportunity cost of selling. If SOCs satisfied

$$p_{st}^* = o_{st} - \frac{Q_{st}(p_{st})}{\frac{\partial Q_{st}}{\partial p_{st}}}$$

$$\tilde{o}_{st} = p_{st} + \frac{Q_{st}(p_{st})}{\frac{\partial Q_{st}}{\partial p_{st}}}$$

estimate a parameterized probability of sale function (with varying elasticities)

instrument (control function) for prices using factors affecting opportunity costs (e.g., seller distance)
Figure 3
Implied Opportunity Costs
Pure Fixed Price Listings

(a) Relative Price Model

(b) Log Price Model
### (a) Counterfactuals for Fixed Price Model

<table>
<thead>
<tr>
<th>Actual</th>
<th>Days Prior to Game</th>
<th>1-10</th>
<th>11-20</th>
<th>21-40</th>
<th>41 plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Price</td>
<td>53.58</td>
<td>60.93</td>
<td>65.81</td>
<td>69.44</td>
<td></td>
</tr>
<tr>
<td>Median Price</td>
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<td>49.50</td>
<td>54.20</td>
<td>58.50</td>
<td></td>
</tr>
</tbody>
</table>

**Counterfactual:** demand parameters same as 11-14 days prior to game  
competition variables same as average 11-20 days before game

| Mean Price | 50.26 | 59.41 | 65.66 | 68.99 |
| Median Price | 39.78 | 49.35 | 55.13 | 59.40 |

### (b) Counterfactuals for Fixed Price Model

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**Counterfactual:** demand parameters same as 11-14 days prior to game  
competition variables same as average 11-20 days before game

| Mean Price | 50.58 | 58.39 | 64.33 | 69.40 |
| Median Price | 40.95 | 49.38 | 54.95 | 59.89 |
Conclusion and Future Research Directions

- robust evidence that prices tend to decline in secondary ticket markets
- strong initial evidence that sellers cut prices because opportunity costs of selling decline as future selling opportunities disappear (because of perishability)
- early buying rational given product differentiation, plausible levels of search costs & risk aversion
- outstanding questions:

  1. why are price dynamics different here vs. airline/advertising markets? demand or commitment?

  2. what drives the choice between selling mechanisms? auctions may become more dominant because of the value of price flexibility